

Interim Annual Report 2018

Pocomoke State Forest

Name of Principal Investigator: Beth A. Middleton

Study Title: Vulnerability assessment of baldcypress swamps to climate change at the edge of the range.

Purpose of scientific study:

The project will examine carbon allocation and sequestration patterns in baldcypress swamps across the continental United States to provide insight into potential changes in carbon sequestration in response to global climate change. Specifically, above- and below-ground carbon stores and primary production will be estimated and compared in 72 sites from 12 locations across the Mississippi River Alluvial Valley, the Gulf Coast, and the Delaware-Maryland peninsula. The results will provide specific information needed to make predictions concerning carbon sequestration in baldcypress swamps in future climate scenarios. The findings will be directly applicable to models of global climate change effects on carbon sequestration. We will test the hypotheses that the rates of leaf litter and root production, carbon sequestration, and above and below ground standing crops are uniform in baldcypress swamps across the continental United States.

The objective of this study is to determine if carbon sequestration patterns differ in baldcypress swamps across the continental United States. This information will be of value in predicting potential levels of future carbon in this major wetland type of North America. Future carbon patterns can be inferred from those of baldcypress swamps experiencing a variety of climatic environments already present along the latitudinal gradient. We will test the hypotheses that the rates of leaf litter and root production, carbon sequestration, and above and below ground standing crops are uniform in baldcypress swamps across the continental United States.

For scientific studies, were any specimens collected?

Beth Middleton and volunteer workers visited the baldcypress survey sites in June and in November. In June Beth and assistant workers set up the leaf litter traps (to measure above-ground production), removed old and inserted new root ingrowth bags (to measure annual below-ground production), surveyed the vegetation (to determine percent cover by species), measured the Surface Elevation Transects (SETs, to monitor elevation) and dendrometer bands (to measure tree growth), took canopy cover photos (to determine leaf area), and sampled soil and porewater. In November they collected the leaf litter samples, downloaded water data, and collected seeds and porewater samples. Throughout 2018 at the Wetland and Aquatic Research Center (WARC) laboratories, we continued leaf litter sample drying, sorting and weighing for samples from previous and current years, and processed root ingrowth bags to determine the above- and below-ground production. Canopy cover photos were downloaded, analyzed using Gap Light Analyzer software, and the results compiled with data from previous years. Vegetation survey and water logger data and SET and dendrometer band measurements were entered

into spreadsheets, porewater samples were analyzed for pH and salinity, and the results compiled with sample data from previous years.

Findings and status for 2018:

PUBLICATION LIST

Edited Books

Davidson N.C., B. Middleton, R.J. McInnes, M. Everard, K. Irvine, A.A. van Dam and C.M. Finlayson. 2018. The Wetland Book, v. 1: Wetland structure and function, management and methods: Springer, Dordrecht, The Netherlands, 12 p., http://dx.doi.org/10.1007/978-94-007-6172-8_356-1
Downloads=46,263

Special Issue Editor

Middleton, B.A., editor. 2018. Large river perspectives in conservation and management. Solutions Volume 9, Issue 3 (July).

Journal Articles

- Middleton, B.A., S. Travis, B. Kubatova, D. Johnson, K.R. Edwards. Morphology and genetics of *Lythrum salicaria* from latitudinal gradients of the Northern Hemisphere grown in cold and hot common gardens. *PLOS One* (in press). [IP-060249](https://doi.org/10.1371/journal.pone.0200249). Previous Invasive Funding. Powell, 3-16-2018.
- Moomaw, W.R., G. Chmura, G. Davies, M. Finlayson, B.A. Middleton, S.M. Nutali, J.E. Perry, N. Roulet, A. Sutton-Grier. 2018. Brinson Review: Wetlands in a changing climate: science, policy and management. *Wetlands* 38: 183–205. [IP-084202](https://doi.org/10.1007/s13157-018-1023-8), [BAO Approval, 11-14-2017](https://doi.org/10.1007/s13157-018-1023-8). Altmetric=121
Downloads=5,700 IF1.9/C2 GX.16.SC00.9HCF4.00 <https://link.springer.com/article/10.1007/s13157-018-1023-8> IF1.6/C2
- Middleton, B.A., P. Montagna. 2018. Turning on the faucet to coastal wetlands. *Solutions* Special Feature, Volume 9, Issue 3 [online: 7/12/2018]. <https://www.thesolutionsjournal.com/article/turning-faucet-healthy-coast/> IP-091390. BAO: Powell, 6/13/2018 GX.16.SC00.9HCF4.00 & National Conservation Leadership Institute IF_/C1
- Osland, M., B. Middleton. 2018. Tropical wetlands in the Anthropocene. *Solutions* Special Feature, Volume 9, Issue 3 [online: 7/12/2018]. <https://www.thesolutionsjournal.com/article/tropical-wetlands-anthropocene-critical-role-wet-dry-cycles/> IP-091390. GX.16.SC00.9HCF4.00 & National Conservation Leadership Institute
- Middleton, B.A., E. Anemaet, T. Elsey Quirk and N.P. Tippery. 2018. *Nymphoides humboldtiana* (Menyanthaceae) in Florida U.S.A. verified by DNA data. *Journal of the Botanical Institute of Texas* 12:257-263. http://www.brit.org/sites/default/files/public/brit_press/JBRIT12-1/JBRIT2018-12-1-257.pdf IP-092397. GX.18.SC00.9HCF4.00. IF0.2C_
- Grandy, I., L. Messina, E. Anemaet and B.A. Middleton. 2018. Sedimentation influences the growth of *Nyssa aquatica* and *Taxodium distichum* seedlings. *Wetlands* First Online, <https://link.springer.com/content/pdf/10.1007%2Fs13157-018-1011-z.pdf>. IF1.9/C_ IP-086969, Powell, 9/22/2017. GX.16.SC00.9HCF4.00
- Middleton, B.A. 2018. Climate and land-use change in wetlands: a dedication. *Ecosystem Health and Sustainability* <https://www.tandfonline.com/doi/abs/10.1080/20964129.2017.1392831> Online, November 25, 2017, Article 1392831. IP-088273, Powell, 9/22/2017.
- Lei, T. and B. A. Middleton. 2017. Repeated drought alters resilience of seed bank regeneration in baldcypress of North America. *Ecosystems* 21:190–201 <https://link.springer.com/article/10.1007/s10021-017-0143-y> IP-068945. BAO approval, Brouwers, September 2, 2016. Press Release. IF4.4/C_
- Middleton, B.A., J. Boudell, and N. Fisichelli. 2017. Using management to address vegetation stress related to land-use and climate change. *Restoration Ecology* 26:1–4. IP-076897. BAO approval, Dec 3, 2016, Powell. Press Release. IF1.9/C1 Altmetric=2
- Osland, M., K. Griffith, J. Larriviere, L. Feher, D. Cahoon, N. Enwright, D. Oster, J. Tirpak, M. Woodrey, R. Collini, J. Baustian, J. Breithaupt, J. Cherry, N. Cormier, C. Coronado-Molina,

J. Donoghue, S. Graham, J. Harper, M. Hester, R. Howard, K. Krauss, D. Kroes, R. Lane, K. McKee, I. Mendelssohn, B. A. Middleton, J. Moon, S. Piazza, N. Rankin, F. Sklar, G. Steyer, K. Swanson, C. Swarzenski, W. Vervaeke, William, J. Willis, and K. Wilson. 2017. Assessing coastal wetland vulnerability to sea-level rise: gaps and opportunities for a regional sampling network. *PLOS One* <https://doi.org/10.1371/journal.pone.0183431>. IP-084947, Doyle, 6/15/2017 IF2.8/C1

Data Release

- Grandy, I., Messina, L., Anemaet, E., B.A. Middleton. 2018. Data Release: Sedimentation influences the growth of *Nyssa aquatica* and *Taxodium distichum* saplings. *Wetlands* IP-087089, 9/22/2017, Wilson.
- Middleton, B.A. Data Release: Geographical trends of decomposition and soil organic matter storage in *Taxodium distichum* swamps of the southeastern United States. (submitted) IP-087093.
- Middleton, B.A., Travis, S.E., Kubatova, Barbora, and Edwards, K.R., 2018, Morphology and genetics of *Lythrum salicaria* from latitudinal gradients of the Northern Hemisphere grown in cold and hot common gardens: U.S. Geological Survey data release, <https://doi.org/10.5066/F74M92P8> IP-080294, 6/14/2017, Doyle.
- Lei, T. and B. A. Middleton. 2017. Data Release: Drought alters resilience of seed bank regeneration in *Taxodium distichum* swamps of North America. *Ecosystems*. IP-084200, 6/14/2017, Doyle.
- Middleton, B.A. and N. P. Tippery. 2018. Data release: *Nymphoides humboldtiana* (Menyanthaceae) in Florida U.S.A. verified by DNA data. IP-093469.

Taxonomic citations of herbarium specimens

Middleton, B.A., and Tippery, N.P., 2018, *Nymphoides humboldtiana* isolate Nind38 trnK gene, intron; chloroplast (GenBank Accession Numbers: MG845508.1, MG845511.1, MG845509.1, MG845512.1, MG845506.1, MG845510.1): National Center for Biotechnology Information, August 28, 2018 <https://www.ncbi.nlm.nih.gov>. (release date, 8/27/2018). Accession numbers: <https://www.ncbi.nlm.nih.gov/nuccore/MG845508> AND <https://www.ncbi.nlm.nih.gov/nuccore/MG845511> AND <https://www.ncbi.nlm.nih.gov/nuccore/MG845509> AND <https://www.ncbi.nlm.nih.gov/nuccore/MG845512> AND <https://www.ncbi.nlm.nih.gov/nuccore/MG845506> AND <https://www.ncbi.nlm.nih.gov/nuccore/MG845510>

Book Chapters

- Middleton, B.A. 2018. Invasive species. *Encyclopedia of Ecology*. C. Jorgensen, ed. Elsevier, Oxford, UK. www.elsevierdirect.com/brochures/ecology/overview.html
- Finlayson, C.M., Davidson N.C., B. Middleton, R. McInnes, M. Everard, K. Irvine, A.A. van Dam, C.M. Finlayson, editors. 2017. Preface. *The Wetland Book*. Vol. 1: Wetland structure and function, management, and methods. Springer, Dordrecht, The Netherlands. IP-083463. BAO Approval: Powell, 1/27/2017, IP-083463.
- Middleton, B.A. 2017. Invasive plant species. *Encyclopedia of Ecology*. C. Jorgensen, ed. Elsevier, Oxford, UK. IP-081245 BAO Nov 21, 2016 Powell.
- Davidson N.C., B. Middleton, R. McInnes, M. Everard, K. Irvine, A.A. van Dam, C.M. Finlayson, editors. 2017. Introduction. *The Wetland Book*. Vol. 1: Wetland structure and function, management, and methods. Introduction. Springer, Dordrecht, The Netherlands. IP-079069. BAO Approval: Powell, 10/21/2016

Reports and Maps

Fidler, T., Heglund, P., Shimp, J., Blodgett, D., Guetersloh, M., Johnson, E., Keefer, M., Mangan, K., Middleton, B., Sparks, R., Speer, R., White, J., and Stanton, J. 2018. Managing the

Middle Cache River to restore and sustain ecological and human values of Buttonland Swamp. A decision analysis workshop report. U.S. Fish and Wildlife Service (in review). IP-091456, BAO Approval, Janine Powell, 2-1-2018.

Rice, K., P. Beier, T. Breault, T., B.A. Middleton, M.A. Peck, J. Tirpak, and M. Ratnaswamy. 2017. Five-year external reviews of the eight Department of Interior Climate Science Centers: SE Climate Science Center: American Fisheries Society, Bethesda, Maryland, 49 p, <https://pubs.er.usgs.gov/publication/70187078> IP-080700 BAO McMahon 2/12/2017.

Fact Sheet, Open File Report

[Conrads, P., K. Rodgers, D. Passeri, S. Prinios, C. Smith, C. Swarzenski, B.A. Middleton. 2018. Coastal estuaries and lagoons: the delicate balance at the edge of the sea. USGS Factsheet 2018-3022. <https://pubs.usgs.gov/fs/2018/3022/fs20183022.pdf> April 2018. IP-094263, Approval Tom Doyle. 1-23-2018.](#)

[Middleton, Beth A. 2018. Wetland forest regeneration dynamics and productivity in southeastern cypress swamp ecosystems. USGS Study Description. May 2018. IP-097880, Approval Tom Doyle, xxxxx](#)

[Middleton, Beth A. 2018. Integrating science and management for optimal prevention and control of invasive *Nymphoides* in Florida \[including matrix modeling and life history dynamics\]. USGS Study Description. May 2018. IP-097883, Approval Tom Doyle, xxxxx](#)

TECHNICAL PRESENTATIONS

Invited Papers at Scientific Conferences and Webinars

- Middleton, B.A. 2018. Society of Wetland Scientists Twitter Conference introduction: wetlands in a changing world and Ramsar COP13. TWITTER. IP-101945.
- Middleton, B.A. 2018. Wetlands carbon management in a changing world. Ramsar Side Event, October 26, 2018, Dubai, UAE.
- Middleton, B.A. 2018. Emerging solutions to climate and land-use problems in world wetlands. Plenary, SWS Joint China-Asia Chapter meeting, August 2018, Changchun, China. IP-099515, Doyle, 8-8-2018.
- Middleton, B.A., 2018, Effects of precipitation extremes on stressed coastal vegetation [abs.], Society of Wetland Scientists 2018 Annual Meeting, Wetland Science: Integrating Research, Practice, and Policy - An Exchange of Expertise, May 29-June 1, 2018, Denver, Colo., 1 p., <https://www.swsannualmeeting.org/>. IP-093892, Doyle, 1-16-2018.
- LePage, B. and B.A. Middleton. 2018. Traditional Ecological Knowledge: a perspective from the world of science. Society of Wetland Scientist, May 2018, Denver, CO. IP-094037, Doyle, 1-16-2018.
- Duvall, A., B. Fiery, B.A. Middleton (instructors). 2018. Unleashing the Power. National Conservation Leadership Institute 2.0 preparatory webinar, 2 sessions, January 2018.
- Murry, B., C. Restrepo, M.T. Rodriguez, S. Burgos-Carabello, S. Torres, B.A. Middleton, J. Bowden, A. Terando, M. Garcia-Bermudez. 2018. Ecological impacts of inter-basin water transfers: implications to environmental flows and river passage under future climate scenarios in Puerto Rico. American Fisheries Society. IP-093791, Doyle, 1-16-2018.
- Middleton, Beth A. 2017. Traditional management of vegetation in wetlands. SWS, June 5-8, 2017, San Juan, Puerto Rico. IP-082601. Center Approval, Doyle, 1/5/2017.
- Murry, B., C. Restrepo, S. Burgos-Carabolla, S. Torres, and B.A. Middleton. Ecological impacts of inter-basin water transfers: implications to wetland distribution, function, and biota. SWS, June 5-8, 2017, San Juan, Puerto Rico. IP-083497, 1/25/2017, Center Approval, Rice.

- Middleton, Beth A. 2017. Rewards and challenges of global research: India and China. SWS, June 5-8, 2017, San Juan, Puerto Rico. IP-082602. Center Approval, Doyle, 1/5/2017
- Middleton, Beth A. 2017. I am a tree: freshwater in forest conservation in the southeastern US. Lightning Talk, Southeast Science Center meeting, Atlanta, April 2017.
- Middleton, Beth A. 2017. Whole river solutions to climate and land-use problems. Departmental Retreat, Florida Atlantic University, Davies, Florida, April 2017.

Invited Seminars, Keynote and Plenary Speeches

- Middleton, Beth A. and Ting Lei. 2018. Sedimentation and vegetation change in Dongting Lake, China Ecopartnership Project. U.S. State Department/People's Republic of China Ten Year Framework, Washington, D.C., June 2018.
- Middleton, Beth A. 2017. Whole river solutions to climate and land-use problems. City College of New York, New York, November 2017.
- Middleton, B.A. 2017. The wind and the salt. Trajectories of vegetation recovery following hurricanes. Sigma Xi Distinguished Lectureship, Statesboro, Georgia, November 2017.
- Middleton, B.A. 2017. Wetlands and climate change. Sigma Xi Distinguished Lectureship, Statesboro, Georgia, November 2017.
- Middleton, B.A. 2017. What next? Drought and flooding in the Big Thicket swamps of the Neches River. Kountze High School, Kountze, Texas, October 2017.
- Middleton, Beth A. 2017. Coastal resilience to salinity intrusion, sea level rise, hurricane, drought & freshwater over-usage. US Fish and Wildlife Service, Annapolis, MD, August 2017.
- Middleton, Beth A. 2017. Fostering global collaboration. SWS, San Juan, Puerto Rico, June 2017 (luncheon speaker).
- Middleton, Beth A. 2017. Whole river solutions to climate and land-use problems. Departmental Retreat, Florida Atlantic University, Davies, Florida, April 2017.

Contributed Papers at Meetings (total = 110) "*" = Presenter, when not B. Middleton

- Middleton, B.A. 2018. Wind and salt: coastal wetland resilience to hurricanes. University of Florida Water Institute Symposium, Gainesville, Florida. February 2018. Center Approval, Tom Doyle, 10/8/2017; IP-091371
- Cooper, Eddie, Middleton, B.A., and Anemaet, E.R., 2018, Be certain before you eradicate: the misidentification of a native *Nymphoides* for an exotic species [abs.], Society of Wetland Scientists 2018 Annual Meeting, Wetland Science: Integrating Research, Practice, and Policy - An Exchange of Expertise, May 29-June 1, 2018, Denver, Colo., 1 p., <https://www.swsannualmeeting.org/>. Center Approval, Doyle, 1/11/2018, IP-093939

- White, E.*, D. Kaplan, and B. Middleton. 2017. Droughts and hurricanes: stochastic weather and climate impacts on groundwater salinity in coastal baldcypress swamps. Society of Wetland Scientist, June 2017, San Juan, Puerto Rico. Center Approval, Tom Doyle, 1/16/2017, IP-084371.
- Middleton, B.A. 2017. Long-term trends of climate, land-use and function in North American baldcypress swamps. US-China Workshop, Xiamen, China. Center Approval, Tom Doyle: 8/19/2016. IP-078751
- Lei, T.* and B. A. Middleton. 2017. Monitoring succession in disturbed marshland vegetation in Dongting Lake. 10th Intecol Wetlands Conference, Changshu, China, September 16-21, 2016

*Presenter